

Aalto University
School of Science
Advanced Materials for Innovation and Sustainability



Alice Aguirre

Project management

Sustainability improvement in luxury packaging: a case study in Giorgio Armani and Helena Rubinstein brands

Master Thesis
Bordeaux, 2020

Workplace: L'Oréal, Paris

Supervisors: Elina Kähkönen and Janne Halme
Advisor: Estelle Bruneau-Demousseau

Author:	Alice Aguirre		
Title:	Project management - Sustainability improvement in luxury packaging: a case study in Giorgio Armani and Helena Rubinstein brands		
Date:	20/07/2020	Pages:	49
Supervisors :	Elina Kähkönen and Janne Halme		
Advisor:	Estelle Bruneau-Demousseau		
<p>Luxury and sustainability are often perceived as contradictory. Luxury packaging are even more pointed at, being associated with waste or overconsumption. In this context, companies, pushed by new consumer generation and regulations, set up strong corporate social responsibility. For cosmetic companies, packaging eco-design is the major vehicle to reduce their environmental impact. This thesis aims to propose solutions to improve the environmental impact of Armani and Helena Rubinstein packaging, luxury brands from L'Oréal. By studying cosmetics and packaging regulations, eco-design principle and the company's own guidelines toward sustainability, the goal is to help both brands to comply with all relevant sustainability commitments, with a focus on recyclability. Based on the ten golden rules for eco-design established by the company, we will understand what are the main challenges when improving a product sustainability. Then, by understanding sorting and recycling centers running, we will list potential disruptors cosmetic packaging can present, in order to build a flowchart of recyclability. For both plastic and glass packaging, this flowchart will help product developers to assess the recyclability of their products, and quantify their progress in recyclability commitments.</p> <p>As a result, we learned that luxury packaging sustainable improvement often involves aesthetic changes. It is challenging to make those changes validated by the marketing, because it affects consumer perception of the product. To make eco-design better applied, it would be useful to find greener solution to propose, without affecting consumer perception. Regarding product recyclability, it was not possible to build an universal flowchart, since recycling facilities vary from a country to another. However, the tool permits to get an idea of the main disruptors encountered on luxury cosmetic packaging.</p>			
Keywords:	Sustainability, luxury packaging, eco-design, recyclability		
Language:	English		

Acknowledgments

Firstly, I would like to express my sincere gratitude to my advisor Estelle Bruneau for having offered me the opportunity to work on this project in her team, for her motivation and support.

I wish also to thanks my supervisors Elina Kähkönen and Janne Halme. They helped me a lot in the preparation and coordination of this thesis, and in the writing of this report.

A special thanks to all my colleagues, especially Desheilla who worked with me in my missions. I am also thankful to the other trainees: Théo, Antoine, Raphaël, Léa and all the others, for their communicative cheerfulness and with whom I loved to work with.

Last but not least, I thank my parents and boyfriend for their precious support especially during the lockdown.

Abbreviations and Acronyms

CDP	Carbon Disclosure Project
CMR	Carcinogenic, mutagenic or toxic to reproduction
CSR	Company Social Responsibility
EMcA	Ellen MacArthur
FSC	Forest Stewardship Council
HR	Helena Rubinstein
LLD	L'Oréal Luxury Division
PCR	Post-Consumer Recycled
PE	Polyethylene
PEFC	Programme for the Endorsement of Forest Certification
PET	Polyethylene terephthalate
PP	Polypropylene
PSI	Product Sustainability Index
PVC	Polyvinyl chloride
REACH	Registration, Evaluation, Authorization and restriction of Chemicals
SBT	Science Based Target
SBWA	Sharing Beauty With All
SPOT	Sustainable Product Optimization Tool
SVHC	Substance of Very High Concern
UNEP	United Nations Environment Programme
WWF	World Wide Fund for Nature

Table of content

Acknowledgments	3
Abbreviations and Acronyms	4
List of figures	7
List of tables	8
Introduction	9
1. Theory part.....	11
1.1 Corporate social responsibility	11
1.1.1 General concept	11
1.1.2 The company responsibility	13
1.2 Luxury cosmetics business area	16
1.2.1 Luxury and sustainability	16
1.2.2 Luxury packaging and sustainability	17
1.3 Existing regulations in the field	22
1.3.1 Regulations related to cosmetics.....	22
1.3.2 Regulations related to packaging.....	23
1.3.3 The company specific rules for packaging materials.....	24
1.4 Guidance towards sustainability.....	25
1.4.1 Eco-design guidance in general.....	25
1.4.2 Eco-design guidance for cosmetic packaging.....	28
2 Experimental	31
2.1 Products studied.....	31
2.1.1 Product A	31
2.1.2 Product B	31
2.2 RQ1: How applicable the 10 eco-design rules are?	32
2.2.1 Approach taken	32
2.2.2 Questionnaire template.....	32
2.3 RQ 2: How to evaluate the recyclability of cosmetics packaging?	33
2.3.1 Information gathering.....	33
2.3.2 Flowchart template	34
3 Results	35
3.1 RQ 1: Applicability of the 10 eco-design rules.....	35
3.2 RQ 2: Evaluation of the recyclability of cosmetic packaging.....	38
3.2.1 Product A recycling	38

3.2.2 Product B recycling	43
Conclusion	46
Limits and perspectives	46
References	47

List of figures

Fig 1 Three pillars of sustainability[5]	11
Fig 2 Carroll's pyramid of corporate social responsibilities [11]	12
Fig 3 l'Oréal's contribution to the United Nations' sustainable development goals [14,15]	14
Fig 4 Packaging materials distribution in 2017 [39].....	19
Fig 5 Sustainable actions of luxury brands.....	21
Fig 6 : An eco-conception model, adapted from [68]	26
Fig 7 The ecodesign wheel [65]	27
Fig 8 SPOT scoring.....	30
Fig 9 Product A.....	31
Fig 10 Product B.....	31
Fig 11 Flowchart template.....	34
Fig 12 Sorting stages of plastic packaging	38
Fig 13 Recycling stages of plastic packaging	40
Fig 14 Recyclability flowchart for plastic packaging.....	41
Fig 15 Flowchart of product A recyclability.....	42
Fig 16 Sorting steps of glass packaging.....	43
Fig 17 Recyclability flowchart for glass packaging.....	44
Fig 18 Flowchart of product B recyclability.....	45

List of tables

Table 1 : Three packaging levers [34,35,36].....	18
Table 2 Informations on Regulation (EC) No 1223/2009	23
Table 3 Recyclability targets of Directive 2018/852	24
Table 4 Eco-design rules with examples	29
Table 5 Product B composition	31
Table 6 Questionnaire template.....	33
Table 7 Answers for the eco-design questionnaire	37
Table 8 Sorting disruptors.....	39
Table 9 Recycling disruptors.....	40
Table 10 Disruptors for glass sorting	44

Introduction

Sustainable development has been a major concern of last decades. Companies are required to take into account social and environmental aspects in both their products and activities, in addition to the economic aspect. Regulations, customers' expectations or competitors often lead those requirements. The luxury sector is entirely concerned because in the one hand, it is not excepted from the application of the regulation and on the other hand, it is considered by some of the companies to have a duty to set an example. In other words, the luxury sector has to seize the opportunity to consolidate its avant-garde position and show an example of the perfect integration of sustainable development, in a context where luxury brands are exposed to criticism.

Packaging in general, but even more luxury packaging has indeed often a negative image regarding its environmental impact. Once used, the packaging is thrown away. It is thus associated with waste, overconsumption and toxicity. However, this packaging, aside from protecting and transporting the product, has additional functions to promote, distinguish and make the product use easier. It is the showcase of brands, so the aesthetic of the luxury packaging is constraint by the brand image. Thus, there is a growing interest to create more sustainable packaging, especially in the luxury sector. The mission of this thesis falls within this challenge.

This thesis takes root in the l'Oréal group ambition to integrate environmental dimension in their packaging and reduce its environmental impact. Positioned as the cosmetics market leader with almost 30 billion US\$ of sales [1], the group is widespread on the 5 continents and on 150 countries. Over the years and since its creation, L'Oréal is considered number 1 of beauty thanks to its expertise and to the acquirement of several innovative subsidiaries. The 36 brands of the group are split into four divisions: The Consumer Products Division (CPD), focuses in mass retailing channels like supermarkets, the Professional Products Division (PPD) sells its products in hairdressing salon all over the world, the Active Cosmetic Division (ACD) meets a range of different skin care needs in healthcare outlets worldwide, including, pharmacies and drugstores. Finally, L'Oréal Luxury Divison (LLD) is composed of brands delivering high quality products and a service aiming at achieving excellence for its consumers. This division outperformed the market in 2019 in the three categories: skincare, perfumes and make-up, with 11 billion euros in sales [1]. The focus of the present study is in this division and more specifically in two brands: Giorgio Armani and Helena Rubinstein.

Giorgio Armani creates perfumes, skin care and make-up around "couture" designs, innovations relying on the best of science and unique textures. To seduce its consumers, the brands takes its inspirations on fashion collections and adds all its knowledge in terms of formulation and technology. Armani is one of the four big brands of the luxury division, with Lancôme, Yves Saint Laurent and Kiehl's. [1,2]

Since 1902, Helena Rubinstein builds its strength on cutting-edge technology to develop its ever more effective anti-aging cares. The brand stem cells expertise permits to offer products corresponding to the expectations of the more and more demanding women.

The brand recently presents one of the higher growing thanks to the ultra-premium skincare products. [3]

The goal of this thesis is to propose solutions to improve the environmental impact of Armani and Helena Rubinstein packaging. Based on cosmetics and packaging regulations, eco-design principle and the L'Oréal's own guidelines toward sustainability. The goal is to help the two luxury brands comply with all relevant sustainability commitments. To reach that goal, I will present the different means of improving the environmental impact of a packaging, based on its life cycle. After evaluating the difficulty of implementing those actions, the focus will be on the end of life of products, studying the recyclability, before studying the development process of implementation of post-consumer recycled material in plastic and glass packaging.

This thesis is organized as follows. The theory part describes the Corporate Social Responsibility (CSR) concept and explains the luxury business, focusing on luxury packaging sustainability. It also presents European cosmetic and packaging regulations, and ends with the eco-design guidance for cosmetic packaging. Then, the experimental part assesses the different methods for improving the environmental impact of luxury packaging and their applicability in the case of Armani and Helena Rubinstein brands. The assessment is done by using life cycle assessment (LCA) on the packaging materials of selected products. Based on the outcomes of LCA, the applicability of the critical improvements is tested by expert interviews in the organization. Finally, the last chapter presents the recommendations for how to implement sustainability guidance for luxury product packaging.

1. Theory part

This chapter presents the general context of my work, articulated around the concepts of corporate social responsibility, luxury business and packaging sustainability.

1.1 Corporate social responsibility

1.1.1 General concept

More than thirty years ago, companies' awareness on sustainability as risen. [4] Since the eighties, national and international organisms have introduced the notion of “sustainable development” which is “the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs”[4]. The Brundtland report [4] established three fundamental pillars to sustainable development: environmental protection, economic growth and social equity [5] (fig. 1).

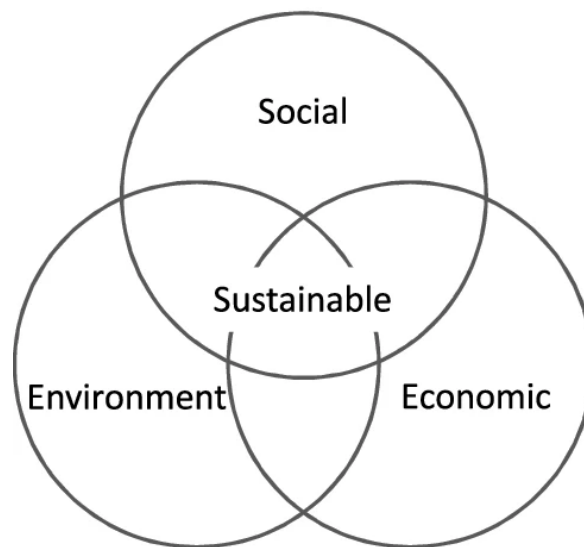


Fig 1 Three pillars of sustainability [5]

To answer to the growing needs in terms of food, energy and manufactured products, Human has affected our ecosystem. He has improved its life quality, consuming more and more the limited resources offered by our planet. The impacts growth is associated with the increasing global population, the industrial development and with the evolution of the consumer society. On the one side, the environmental impacts concern the overexploitation of resources, soil (waste), water (eutrophication) and air (climate change) pollution as well as human health (cancer) and biodiversity (species extinction) [6]. Furthermore, the race for profit has conducted companies to unethical practices, such

as child labour [7]. Those three pillars are therefore linked and it is essential not to neglect one of them.

To attain sustainability, the United Nation of Environmental Programme (UNEP) proposes to spread the responsibility between public authorities, consumers and companies. Companies hold the main action levers [8]. Assuming this, the notion of Corporate Social Responsibility (CSR) was born.

Corporate Social Responsibility (CSR), which is defined by the European Commission as “companies taking responsibility for their impact on society” [9], is an issue that is getting more and more important for brand’s reputation.

CSR covers very large aspects of companies, from ethics or activities transparency to greenhouse gases emissions or harm to biodiversity. This concept have been the subject of many investigations and has various definitions and representations. One of the most simple and well-known representation is Carroll’s CSR pyramid (Fig.2). According to Carroll [10], “corporate social responsibility involves the conduct of a business so that it is economically profitable, law abiding, ethical and socially supportive. To be socially responsible then means that profitability and obedience to the law are foremost conditions when discussing the firm’s ethics and the extent to which it supports the society in which it exists with contributions of money, time and talent”. She proposed to represent the concept by a pyramid that translates the four main types of obligations that society expects of businesses (Fig.2).

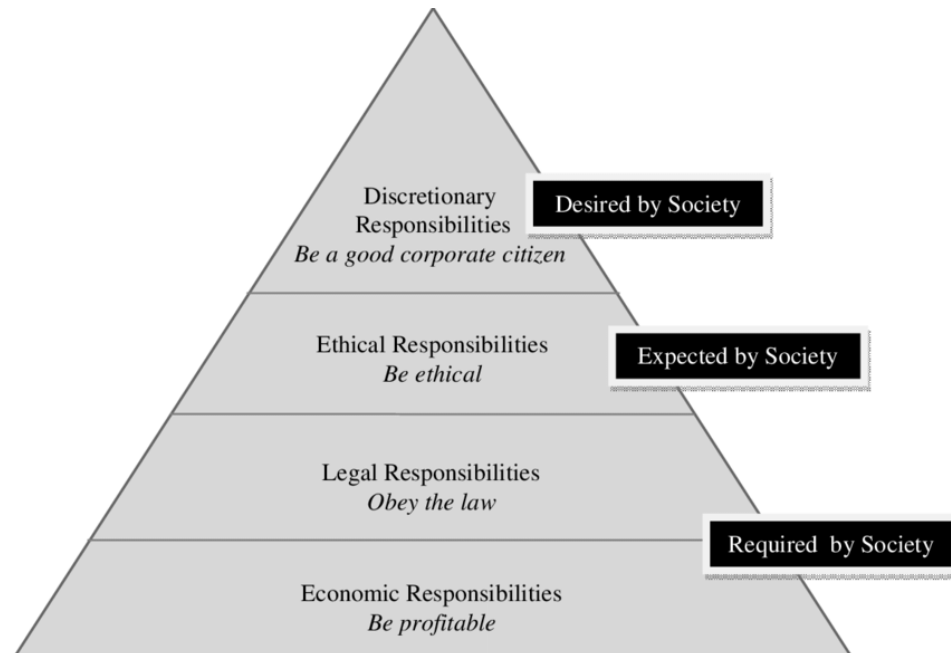


Fig 2 Carroll's pyramid of corporate social responsibilities [11]

The base of Carroll’s pyramid concerns the responsibility of business of producing goods and services needed by society and selling them making a profit. It is presented as the foundation up which all others rest. Then comes the legal responsibility, demanding that businesses abide by the law and play by the rules of the game. Upwards, the important

concept of legal responsibility translates what is generally expected by society over and above economic and legal expectations. There are generally not guided by the law, but expected from consumers and governments. Finally, at the top of the pyramid appears the discretionary responsibilities, also known as philanthropic responsibilities. This concept is not essential and not often present in the CSR research topics. It includes philanthropic efforts such as donations or programs that encourage employee volunteerism. [10,11] The subsequent parts follow the pyramid structure, tackling the subjects of economics, legal responsibilities and ethical responsibilities.

1.1.2 The company responsibility

a. Self-developed guidance

CSR has become an important part of brand value and it is considered to have growing importance in sales in the global company in our case. For instance, a study showed that 88% of the people surveyed would prefer buying products from responsible company [12]. This shift is driven by millennials, which are more sensitive about environment and responsible consumption [13]. In this context, L'Oréal has implemented its own program: "Sharing Beauty With All" (SBWA) [14]. The attempt covers all the activities in the company. The program is articulated around four areas: Innovating sustainability, producing sustainability, living sustainability and developing sustainability, with commitments towards 2020. With this program and its strong involvement in promoting diversity and inclusion, the group contributes to 14 of the 17 Sustainable Development Goals created by the United Nations in 2015 [14, 15]. Among those 14 goals, my thesis mainly entrenched three of them: responsible consumption and production (n°12), climate action (n°13) and life on land (n°15).

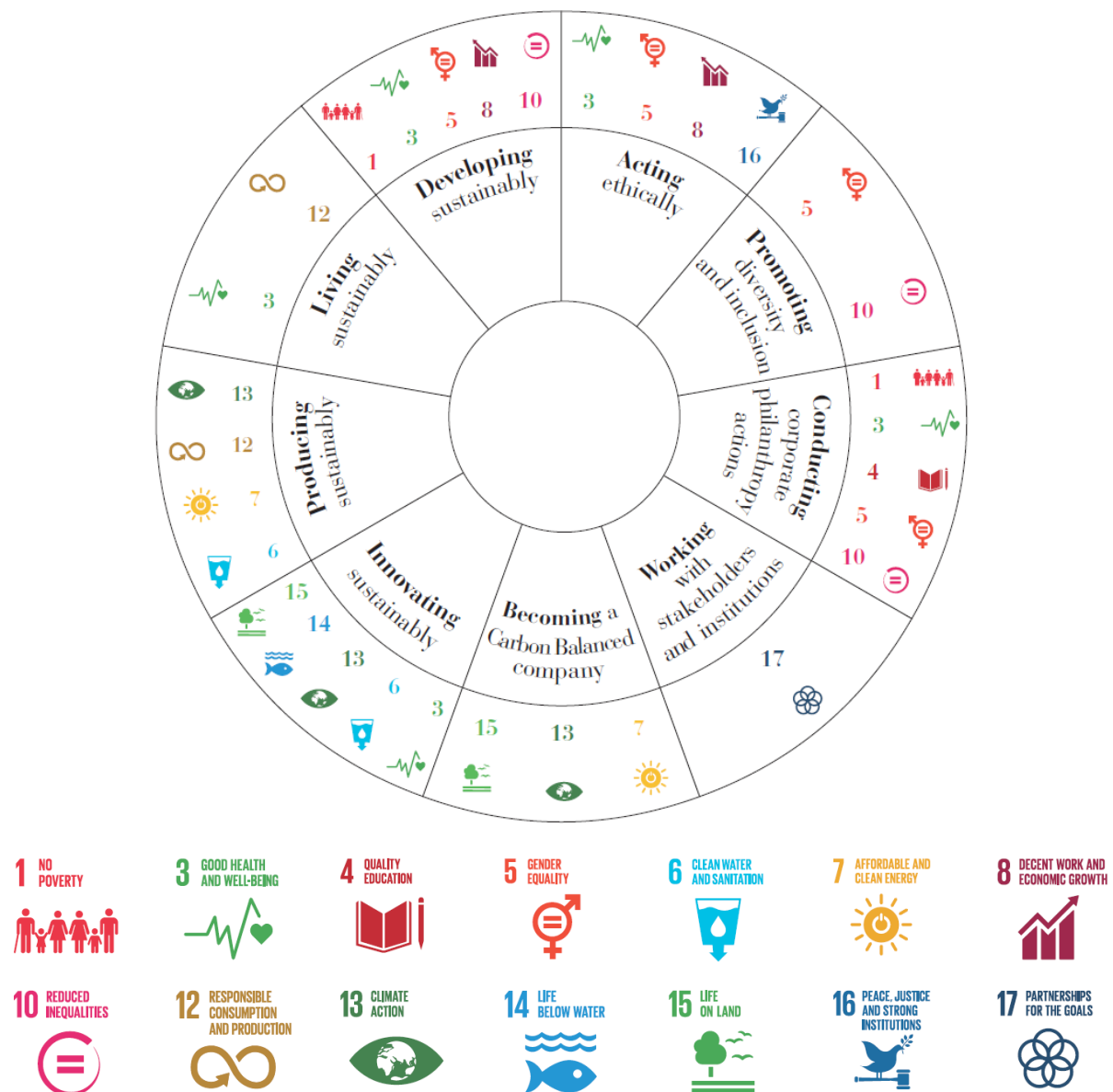


Fig 3 l'Oréal's contribution to the United Nations' sustainable development goals [14,15]

The innovating part aims at improving the environmental and social profile of all its products. The goal was to achieve 100% of the product improved by 2020. This result can be evaluate with the tool SPOT, for Sustainable Product Optimization Tool, developed by l'Oréal, further discussed in part 1.4.2.b. The pillar producing sustainability contains the efforts on CO2 emissions and water consumption during manufacturing.

The two other pillars concern the social aspect of the SBWA program, with philanthropic activities. Living and developing sustainability include activities in the fields of providing safe drinking water or employment of underprivileged communities. For instance, since 2010 Armani has partnered with UNICED USA for its Acqua for Life campaign, to help expand access to safe drinking water in several developing countries. [16]

b. External sustainable commitments

If L'Oréal has strong internal sustainable commitments with the SBWA program for 2020, the group has completed its strategy by being engaged in external commitments for coming years. Concerning different steps of the product life cycle, the focus is mainly on virgin plastic use reduction and products recyclability.

Upstream, regarding the materials used in packaging, L'Oréal 2025 goal is to use either recycled origin or bio-sourced plastic. The roadmap plastic commitment supports that at least 50% of the plastic used will be from one of these sources [17]. Bio-sourced plastic will be favored only if it has a better environmental and social impact compared to virgin plastic. This is why for each new bio-based plastic source a life cycle assessment should be realized by experts.

Downstream, the group is engaged to reduce the packaging end of life impact. To do so, L'Oréal has become a partner of the Ellen MacArthur Foundation. The charitable organization was launched in 2010 by the sailor Dame Ellen MacArthur to accelerate the transition to a circular economy [18]. It works with partners across key sectors of the economy to demonstrate circular innovation at scale. Big companies such as H&M, Google, Danone or Unilever became part of the mission [19]. The goal is to make 100% of plastic packaging refillable, recyclable or compostable [17,19]. Once again, the use of compostable materials is preferred only if true in real life conditions: ambient temperature and humidity. The EllenMacArthur foundation has determine some recycling conditions in order for the commitment to fit with the different sorting and recycling centers worldwide. To do so, they established a definition of recyclability: "A packaging or packaging component is recyclable if its successful post-consumer collection, sorting, and recycling is proven to work in practice and at scale." By "in practice and at scale", it means that all over the world, 400 million inhabitants can recycle the product at 30% recycling rate [19].

Only four formats in Armani and Helena Rubinstein scope meet this requirement: PET, PP or PE bottles and PE jars. All other formats and materials are considered non-recyclable for the EMcA commitment.

Another condition is to decide that from 95% up, product is considered 100% recyclable [19]. That means that if the product has a small component (<5% in weight) which does not prevent the recyclability of this product but that is not recyclable itself, it is assumed that the entire product is recyclable.

For 2030, the Science Based Target program plans the group's commitments [20]. This program was born after a collaboration between NGOs such as World Wide Fund for Nature (WWF) or Disclosure Insight Action CDP [21]. Established in the way to limit global warming to 1.5°C, this program helps companies to define strong environmental targets in order to reduce greenhouse gases [20,21]. In this way, L'Oréal plans to lower its carbon emissions by 25% in absolute terms, compared to 2016 [20].

Those three main commitments are resumed in the table below.

Commitment	Year	Target
Ellen MacArthur	2025	100% of plastic packaging will be refillable, rechargeable, recyclable or compostable
Roadmap plastic	2025	50% of the plastics used in packaging will either be of recycled origin or bio-sourced
Science Based Target	2030	Carbon emissions will be lower by 25% in absolute terms compared to 2016

Table 1 : L'Oréal sustainable main commitments

Part of my mission is to help Armani and Helena Rubinstein brands to reach those commitments. The focus is on 2025 commitments, by studying the recyclability of products and finding ways to implement recycled origin sourced plastic.

1.2 Luxury cosmetics business area

1.2.1 Luxury and sustainability

Originally, the word "luxury" comes from the Latin word *luxus*, which means indulgence of the senses, regardless of cost [22]. At first sight, luxury may seem incompatible with sustainability and is accused of the waste of resources that could be needed for industries that are more useful. [23] It is also a symbol of social inequalities being reserved to elite. [24]

Luxury products are associated with vanity, considered as non-essentials and bought only to change consumers' appearance or as a mark of social distinction. Therefore, this is a sector ecologists pointed out regarding various parameters [25]: the presence of toxic substances, animal testing, ingredients' origin, companies' responsibility in deforestation or environmental impact. Thus, luxury companies have to deal with the paradox between sustainability and luxury, especially regarding waste Furthermore, luxury is associated with creative liberty, distinction, pleasure and wealth with opposition with sustainability which has a connotation of simplicity and altruism [25,26]. Luxury packaging challenge is mainly focused on environment. Luxury brands should combine those two paradoxal notions, presented in table 2.

Luxury	Sustainability
Wealth	Simplicity
Pleasure	Needed
Scarcity	Renewable
Distinction	Sharing
Creative liberty	Constraint

Table 2 : The sustainable luxury paradox [23,25,26]

However, luxury DNA has some common points with sustainability: the preservation of rare materials and expertise to propose exclusive products. The high price limits the mass consumption. Luxury products promotes local fabrication, and their high quality makes them sustainable in opposition with obsolescence. [22,27]

Despite those common points, consumers consider that luxury brands should go further and begin a deep change to be more responsible and to better integrate sustainability dimensions [26,27]. One of the challenges, especially in the present case, is that luxury brands have the same sustainable commitments as those for other brands including those of the mass-market sector. The constraints generated by those commitments are often more easily implemented in mass-market products than in luxury ones. For example, a mass-market product has often a simple composition, with one or two materials, making it more adapted for recyclability, in opposition with complex packaging used in luxury products. If this makes it very challenging for luxury brands, this particularity pushes luxury division to make efforts regarding the environment.

Another challenge for luxury industries is to consolidate their forward thinking image, to be pro-active using creation and innovation. Luxury brands are indeed known for creating the trends, not following them. With the evolving culture of climate change concern, consumers are demanding for sustainable and conscious practices. This is the opportunity for the luxury industry to change its business model, favoring innovation in products and operations in order to stay aligned with people's values [29]. This aspect is even truer for L'Oréal, since it is the market leader in cosmetics and the luxury division is one of the main growth driver of the group [30]. The change has started for luxury companies. As an example, Marie-Claire Daveu, from the luxury group Kering's has affirmed that "The ambition is to redefine luxury to help influence and drive these positive changes" [31].

1.2.2 Luxury packaging and sustainability

Packaging tackles aesthetic constraints due to its important role in brands value. This challenge is emphasized for luxury products. To answer to their luxury code, cosmetic packaging are often voluminous, heavy and with complex materials such as metallized plastic to get a shiny aspect. Those particularities raise the question of waste and recyclability. After defining packaging and its roles, packaging sustainability is studied.

a/ Packaging definition

Packaging is an old concept, created many centuries ago. It was manufactured with wood, soil, or animal leather and was used to stock, protect and transport commodities such as wheat, oil or wine [32]. Packaging's role has evolved since the development of self-service market. In opposition with traditional market, where the seller makes the link between the product and the consumer, in the self-service market, the product is dissociated with its seller. The consumer has to choose between several competing products. Packaging becomes the new and only promotion and communication tool on the product and its brand [33].

It is important to distinguish the three packaging levels [34] (table 2) :

- **Primary packaging:** the one that generally touches the product, protects it and informs or attracts the consumer.
- **Secondary packaging:** outside the primary packaging, its main goal is to protect the primary packaging, and to make the transportation easier. Sometimes it permits to stock various objects such as user manual or cosmetic accessories.
- **Tertiary packaging:** also referred to as transit packaging, its aim is to facilitate the transportation of many products and to group them.

Primary packaging	Secondary packaging	Tertiary packaging
		

Table 1 : Three packaging levers [34,35,36]

Those three types of packaging perform numerous functions [33,34,37]. The packaging can protect the product from the packaging plant right up to the end consumer. It enables the product to be shipped all over the world. It also protects the product against external conditions, such as oxidation or contamination. It prolongs the product's useful life and thus reduce waste. It provides access to distribution and use of the product. It informs consumer about the product, its ingredients and conditions for use. Finally yet importantly, it is a promotional and advertising medium for the brand. It is an element of differentiation being brand's showcase, embodying brand's values and codes. This aesthetic importance is the biggest constraint for implementing sustainability in the packaging, as presented later.

b/ Economic, environmental and social aspects of packaging

In the middle of the three pillars of sustainability, packaging is not presented as sustainable, but more as a waste. A French household indeed throws away about 10 packaging per day [38]. This part presents each of the three pillars of sustainability: economic, environmental and social, linked to packaging.

Economic

World packaging market in 2017 was approximately of 851 billion US\$ and may reach 1000 billion US\$ in 2023 [39]. This rise is due to the demographic growth, e-commerce development, product availability and to the mutation of traditional market to pre-package product market [39].

Regarding the repartition of packaging materials, paper/cardboard and plastic packaging are predominant with 35.7% and 41.5%, respectively. The need of corrugated board has exploded with the development of e-commerce and is estimated at 245 billion US\$ in 2017 for 143 million tons. The use of flexible materials has evolved to replace rigid plastic in food industry to propose lighter alternatives [39]. All the packaging materials are in the scope of our study.

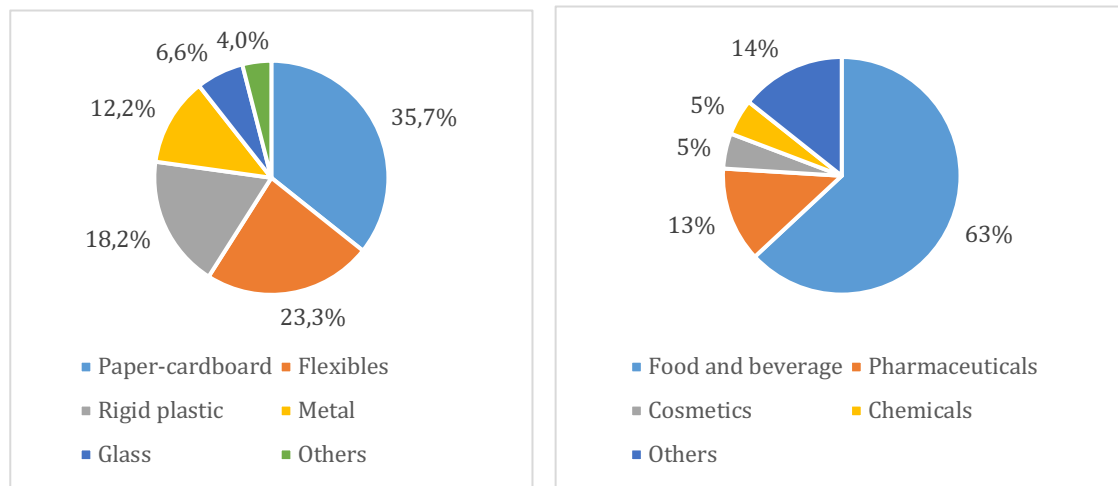


Fig 4 Packaging materials distribution in 2017 [39]

Regarding the different sectors, the food market is largely predominant with a turnover of 274 billion US\$ in 2017. Regarding the cosmetic industry, it represents 29,6 billion US\$ and luxury packaging 14 billion US\$ in 2017 [39].

Environmental

The packaging industry is associated with several environmental aspects such as waste, resources consumption or toxicity. According to company's own studies, 50% of the environmental impact of a product is linked to its packaging [17].

After use, most of our packaging made of different materials are landfilled, and take hundreds of years to decompose. Some of them do not decompose at all. Regarding plastic packaging, whose major problem is the end of life, only 23% of all the plastic packaging produced is recycled [40]. This is a major problem for the environment, especially for ocean and soil pollution. Researchers affirmed that by 2050, if nothing has changed, there will be more plastic than fish in the ocean [41].

Finally, regarding resource consumption, the production of packaging is very impacting. Packaging industry absorbs 40% of consumed plastic in Europe [42], knowing that the worldwide plastic production necessitate 8% of petrol [43]. Regarding glass packaging,

unlike most people can think, it is not necessarily more sustainable than plastic. Glass production indeed requires a lot of energy, because it needs to be heated for manufacturing, and as glass is heavy, the transportation energy cost is very high. The total greenhouse gas emission for transportation and manufacturing is 101 grams for the plastic, and 265 g for the glass packaging. However, glass packaging can be theoretically recycled infinite times. Using three times a glass bottle is almost equivalent to using a single used plastic once [44].

About paper or cardboard packaging, every year 4 billion trees are cut down, leading to the destruction of biodiversity and increase of CO2 emission. [45] Different legislations push the industry to limit its impact regarding all of those aspects, and are presented later in this document.

Social

When people speak about packaging sustainability, the focus is often on the economic or on the environmental aspect, but the social component of sustainability has not received much attention. This can be explained by the fact there are not well-established methods to quantify this aspect [46]. However, packaging can be linked to several social aspect, either positive or negative.

The first aspect concerns the supply chain, regarding work intensity, faire wages or workforce diversity, but it is not specific to the packaging, but more on the industry itself. Thus, the supply chain issue is not the focus here [46].

Packaging facilitate the purchase of non-local products thank to a better conservation and easier transportation and consequently reduce local market. The positive side is that it permits to non-developed countries to have access to food provided around the world [47]. Regarding the product, the packaging can encourage the overconsumption because of the aesthetic aspect and the needs it creates. If it enables people to make their lives easier, for example with the development of single household portion, is favors waste [47].

Finally, packaging plays a safety role, protecting and informing the consumer to ensure that medication or food stay fresh and well protected [37].

c/ Towards sustainable luxury packaging

Luxury brands use packaging to show their values and convey prestige. Over the time, packaging importance has risen and certain materials and shapes have been associated to luxury in customer's eyes [48].

The main colors people associate with luxury are gold, black, silver and white. Concerning the shape, luxury packaging is often associated with an excess of volume and weight. (ref citeo) heavy packaged are indeed considered as more luxurious, in contrast with light packaging, looking shoddy in people's head [49]. Some luxury brands have a strong tradition linked to their packaging design; the black color for Armani for example or the

use of glass for Helena Rubinstein. As presented later, all those materials and shapes associated with luxury are a brake to sustainability, especially for recyclability.

However, if a decade ago the packaging design was essential for customers, today the minds are shifting and people are more and more environmentally sensitive. A study from CITEO [50] showed that on 500 people surveyed, 77% of them would shift away from a luxury brands if their packaging is not environmentally friendly, and 95% of them are under 35. This same study asked about the responsibility when improving the environmental impact of packaging, and 75% of people surveyed answered that that was the manufacturer responsibility. Thus, a trendsetting company should be the driver of this change, by proposing to the new generation greener packaging while keeping brands image.

One might consider if focusing in the luxury packaging has relevance due to its small size. With 15 billion US\$ turnover in 2016, the luxury packaging industry indeed represents only 3% of the total packaging industry [51]. However, the trend setting of luxury brands pushes them to work on their packaging sustainability. Customers are demanding for authenticity, transparency and communication [52]. Many luxury brands have made good progress in this sustainable transition, adopting various strategies. For example, one competitor (Thierry Mugler), have stand out working on refillable perfumes, creating the Mugler Fountain, which permits to refill perfume bottle directly in retail store (Fig. 5.a). This innovation has permitted to save 2.3 million bottles and boxes every year [53]. Others favored the lightening of their packaging. This is the case of the *Abeille Royale* product of Guerlain (Fig. 5.b), renovated with a lightening of -62% in weight [54]. Furthermore, one of the company's own luxury brands (Kiehl's) have succeeded implementing 100% of post-consumer recycled plastic (PCR), which is plastic made from recycled products, in its liquid hand soap *Coriander* (Fig. 5.c)[55].



(a) The Mugler Fountain, Mugler (b) Abeille Royale, Guerlain (c) Hand Soap Coriander, Kiehl's

Fig 5 Sustainable actions of luxury brands

Thus, if luxury packaging represents a small part in the overall packaging environmental impact, the significance does not come only from numbers; luxury brands has the power

to be pro-active in the sustainable transition, and some brands have already started to make the change.

1.3 Existing regulations in the field

This chapter presents the main regulations related to cosmetics. The cosmetics regulations focus largely on verifying safety of the products during use. The product composition is the main target of the regulations, but the packaging material is closely in contact with the products and, hence, a target for the same regulations. In this study, the scope is limited to European regulations, but the regulations presented can differ in other areas such as Asia.

1.3.1 Regulations related to cosmetics

Regulation (EC) No 1223/2009 on cosmetic products [56] is the main regulatory framework for finished cosmetic products placed on the European (EU) market. This regulation assures high level of protection of human health and affects different actors of the cosmetic industry, from the ingredients supplier to the manufacturer.

To define the scope, cosmetic products are defined by the European Parliament and the Council as *“any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odors”* [56].

This regulation targets a multitude of aspects related to the manufacturing and labeling of cosmetics products. It includes safety and responsibility, the creation of a product information file, the restriction of certain substances and the control of animal testing.

Those can be summarized in a table:

Aspect	Description
Safety, responsibility	A product released on the market shall be safe for human health, taking into account : presentation including conformity with Directive 87/357/EEC, labelling, instructions for use. A representative of the manufacturer, named as the “responsible person”, must provide a safety report.
Product information file, notification	The responsible person must maintain a product information file for each cosmetic product. It should be accessible to public and government for at least 10 years. The file should contain the description of the cosmetic product, the cosmetic product safety assessment, a description of the

	method of manufacturing, proof of the effect claimed for the cosmetic product and data on any animal testing performed.
Restrictions for certain substances	<p>The regulation has set out banned and restricted substances in cosmetics. There are presented on different lists :</p> <ul style="list-style-type: none"> - Prohibited substances - Restricted substances - Colorants - Preservatives - UV-filters - CMR substances - Nanomaterials
Animal testing	<p>The regulation implements two types of ban :</p> <ul style="list-style-type: none"> - <u>Testing ban</u> : to prohibit the animal testing of finished products or cosmetic ingredients - <u>Marketing ban</u> : to prohibit finished products or cosmetics ingredients in the EU tested on animals to the market

Table 2 Informations on Regulation (EC) No 1223/2009

If the Regulation (EC) No 1223/2009 is global for cosmetic products, some regulations are more specific to packaging, especially to packaging waste. Some of those regulations are presented in the following part.

1.3.2 Regulations related to packaging

EU directive on Packaging and Packaging Waste [57]

The objectives of directive 94/62/EC of 20 December 1994 on packaging and packaging waste are to harmonize national measures concerning the management of packaging to ensure a high level of environmental protection and the reduction of waste. Concerning the scope, it covers all packaging placed on the market, used or released in shops, households or any other place, regardless of the material used. As packaging, it means *“all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. ‘Non-returnable’ items used for the same purposes shall also be considered to constitute packaging”* [57].

In 2018, Directive (EU) 2018/852 amends Directive 94/62/EC and contains updated measures considering circular economy [58].

The main requirements of this directive focus on the limitation of packaging weight and volume regarding the required level of safety and hygiene, the reduction the amount of hazardous substances and materials and the encouragement of reusable packaging.

It also established rules concerning the recyclability of different packaging materials by 2025 and by 2030. The targets for plastic, wood, ferrous metals, aluminium, glass, paper

and cardboard vary from 25 % to 75 % for 2015 and from 30 % to 85 % for 2030 [58] (table 3).

Material	2025 recyclability target	2030 recyclability target
<i>Plastic</i>	50 %	55 %
<i>Wood</i>	25 %	30 %
<i>Ferrous metals</i>	70 %	80 %
<i>Aluminium</i>	50 %	60 %
<i>Glass</i>	70 %	75 %
<i>Paper and cardboard</i>	75 %	85 %

Table 3 Recyclability targets of Directive 2018/852

REACH (Registration, Evaluation, Authorization and restriction of CHemicals) [59]

Established in 2007, REACH regulation aims to protect human health and the environment by evaluating the limitation of hazardous substances used in finished products. The regulation checks that the product put on the EU market is free of SVHC or Substance of Very High Concern. A SVHC is a substance classified as cancerogenic, mutagenic, toxic for reproduction or persistent and bioaccumulative. This restriction is applicable for several types of packaging such as plastic packaging, paper packaging or steel packaging. A list of hazardous substances is provided and prohibits for example Bisphenol P or Dihexyl Phthalate.

1.3.3 The company specific rules for packaging materials

When developing a new product, L'Oréal employees should evidently take into account the different regulations linked to their product in order to be able to sell them in the market. However, the group has also decided to develop its own packaging policy.

Regarding the materials used, L'Oréal has decided, since 2018, to stop using PVC-based materials in their finished products [17]. PVC has indeed several environmental issues, warned in 2000 in a Green paper by the commission of the European communities [60]. This report presents the different problems appearing in the all life cycle of PVC. The most impactful is the need of additives, especially hazardous stabilizers such as heavy metals or chlorine, used to make the PVC flexible. The use of such materials is dangerous for human health, it can develop cancer or hormone disruption [60]

Moreover, the Group has decided to demand food grade certified material for the packages in direct contact with the formula [61]. This prevents migration of the possible residuals or impurities from container to the content, assuring the good safety and conservation of the product. For that, the group applies European Directive 2022/72/EEC [62]. To be foodgrade compliant, each packaging should conduct lab testing under different temperature conditions. This regulation is constraining when

using recycled materials, because some substances can remain in those materials, making the food grade test fail [62].

Regarding wood-based packaging, the Group has the ambition to make paper and cardboard packaging from sustainable managed forest [63]. This aspect is certified by FSC or PEFC standards, for Forest Stewardship Council and Program for the Endorsement of Forest Certification. Both certifications aim at ensuring the good management of forests and protect them against destruction [64]. Today, the company informs that it has achieved 100% of the paper and 99,9% of the cardboard made from sustainable managed forest, according to both certifications [63].

1.4 Guidance towards sustainability

1.4.1 Eco-design guidance in general

Design is the essence of how a product is formed, and it is the key basis for sustainable innovation [65]. The EU has established Eco-design directive to force inclusion of environmental dimensions in product development [66]. It should integrate environmental dimension over the all life cycle of the product, from its production to the end of life. Furthermore, academia and other institutions have developed guidelines and concepts for eco-design. In 2013, Lindahl and Ekermann have defined eco-design as “a way of better design through analyzing and synthetizing in order to reduce environmental impact throughout the product’s life cycle” [67]. Today, there are numerous definitions, concepts and tools for eco design [67]. For this study, the approach presented is established by an association called Pôle Ecoconception. Its role is to help companies to better integrate eco-design in their strategy [68].

The approach can be represented by a wheel articulated around 6 steps (Fig. 6)

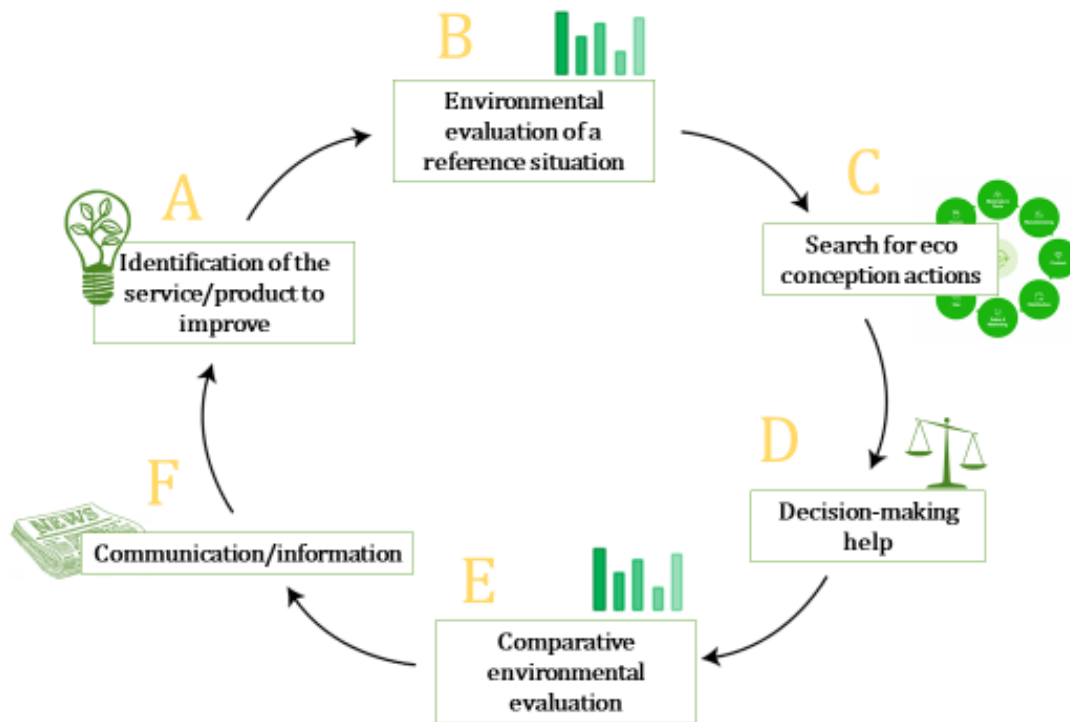


Fig 6 : An eco-conception model, adapted from [68]

The step A is the first step, which consists in identifying the service or product the company wants to improve. This choice should be argued and justified. The need can come from customer demand, marketing demand or a change to complete the company's commitments. The strategy can differ from a project to another. One solution is to choose the product that presents the biggest volume of sales to have a real impact on the environment. However, another possibility can be to choose a product that has smaller quantities to control the risk levels if the process is new. Customers perception should not be neglected, but it can happen that there is a shift between what people think and the reality of the benefice for the environment. This shift can lead to what is called today "greenwashing", which should be avoided. The Cambridge dictionary defines greenwashing as the "behavior or activities that make people believe that a company is doing more to protect the environment than it really is" [69].

This is the reason why step B is crucial. It will answer to the questions: What are the real environmental issues of my product? Which life-cycle stage does it affect? To which product would I compare the new product? For a new product, an expert team should realize a life cycle assessment to evaluate the environmental impact of this product. For a renovation, the new product is compared to the old product or a similar product.

Once the reference is chosen, step C scans the all product life cycle to select the most relevant action to put in place for the product eco-conception, from the extraction to the end of life of the product (Fig.7). After designing the product, the choice of the materials can be very impactful. For example, it is preferable to choose recycled or long lasting materials [65]. Then, comes the manufacturing stage. The process should be optimized in

order to save energy or reduce waste. After the product is transported to be distributed in the different selling places. This step can have a big impact on the product's footprint, so it is important to improve the entire logistical transportation, from storage to the delivery to customer. Local manufacturing can answer this potential issue, since it permits to avoid air traffic, the most impacting means of transport [69]. The next step of the eco-design wheel concerns the point of sale. There are different ways to improve the stores sustainability, for example by reducing the amount of materials in point-of-sale displays, or using low-power lightening. Finally, after the product is used, its end-of-life is the key point to close the loop. Thus, it is important that the product be composed of recyclable materials, or be designed for recovery and recycling. The experimental part of this thesis will detail the conditions for product recyclability.



Fig 7 The ecodesign wheel [65]

To choose among all those possibilities, it is important to consult the collaborators implied on each improvement. Step D (Fig.6) is crucial to make a decision. This calls for a work with buyers to consult subcontractors or find others ones, depending on the technical feasibility and cost. If the change implies a new design, it is essential to consult the marketing. Those are examples, but each path studied involves several persons to consult [68].

Now that one or more solutions are proposed, step E permits to assure that the new product is better than the reference. This step necessitates conducting a new LCA, considering the new parameters with the same methodology used for step B.


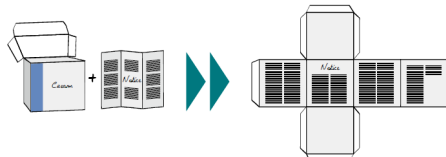

Communication on the eco-designed product is the final step of eco-conception. The goal is to lend credible to the eco-designed product, to avoid greenwashing and reinforce the company image. Standard for communication exists, the ISO 14020. It describes four targets regarding to communication: the message should be relevant, exact, verifiable and not misleading [70].

1.4.2 Eco-design guidance for cosmetic packaging

a. Golden rules for packaging eco-design

The eco-design model presented is applied for cosmetic packaging. When looking at the life cycle of a luxury cosmetics product, the packaging is often the most impactful [17]. It includes the processing of the raw material, its transformation and transport to the filling and packing site. To reduce significantly the impact of a product, the solution is to eco-design its packaging.

Following the guidelines presented in part 1.3 and driven by the sustainable commitments, L'Oréal established 10 rules for eco-design, presented in table 4 with an illustration of a concrete example for each rule [71]:

Rule	A group example
Only use packaging that is safe for human and environmental health	PVC suppression
Reduce materials use (weight and/or volume)	1L shampoo, reduction of 13% of its weight 
Do not use excess or unnecessary packaging	Removal of instruction, printing on the back of the carton 
Give preference to large formats whenever possible	Garnier Fructis maxi format 400ml 
Give preference to materials which have less impact	Cardboard tube La Roche Posay

	
Only use paper& cardboard that comes from sustainably managed sources	FSC, PEFC certification
Avoid burden shifting wherever possible	Lighter bottle permits to save materials, but as a result, pallets cannot be stacked. More trucks are then needed to transport the finished product.
Reuse	The formula of Aqua Magnifica of Sanoflore is refillable 
Guide consumers in their eco-friendly gestures	Mention “remove the pump from this bottle before putting it in the recycling bin” 
Make sure your packaging ends its life respectfully	Use of compatible plastics for recycling 

Table 4 Eco-design rules with examples

b. A tool for eco-design: SPOT

To facilitate the eco-design and communication related to environmental impacts of new launches or to renovate products, L’Oréal has developed its own evaluation tool SPOT, for Sustainable Product Optimization Tool. With the support of international experts, this tool has been created to score the environmental and social impact of every product, taking into account many criteria all along the life cycle of the product [72].

On the one hand, the environmental score includes the impacts coming from three sources: the packaging, the formula and the manufacturing. For each of those sources, several criteria are taken from the fourteen criteria established, such as CO2 emissions. They are weighted considering actual resources limitations and world's environmental challenges. For example, the biodegradability of the formula or the recyclability of the packaging are weighted.

On the other hand, SPOT is the 1st methodology that calculates the social impact of cosmetics products on their stakeholders: employees and suppliers, local communities and consumers. The focus is based on three criteria: fair practices and working conditions, health and safety, social and community development.

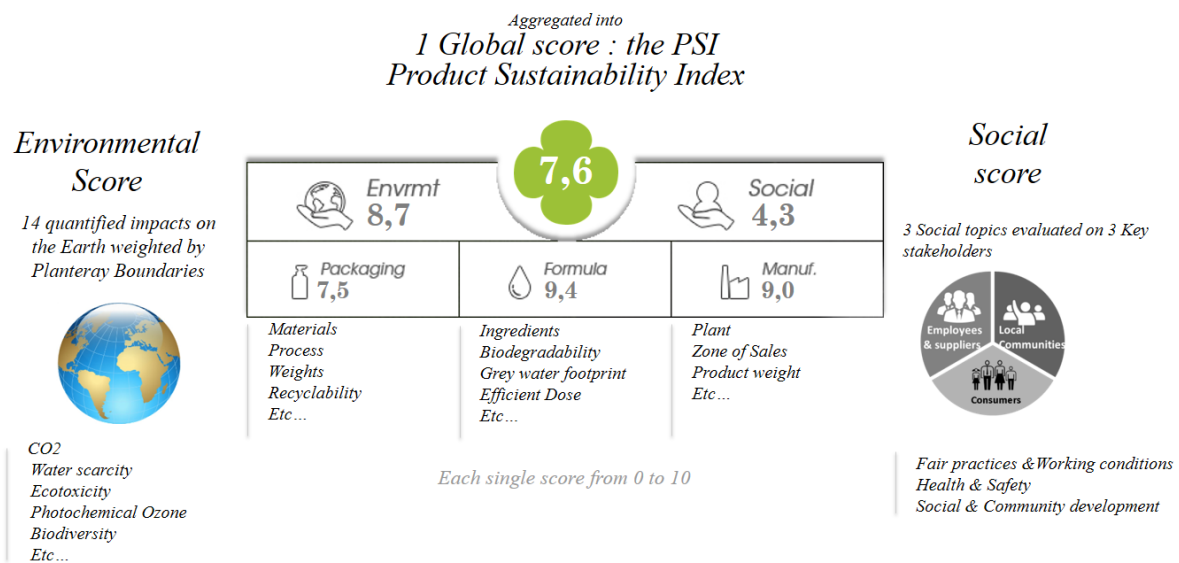


Fig 8 SPOT scoring

Thus, the environmental and social scores define the final score of the product, called the Product Sustainability Index, or PSI. The maximum score is 10. The closer the product to 10, the better its sustainability.

If this tool permits to score each product, it can also be used as a simulation tool. By changing different parameters such as the packaging materials or supplier, the score increases or decreases, helping the identification of potential design improvement. For instance, if the product evaluated on Fig.8 is renovated, the new product should have a score higher than 7.6. In this thesis, the simulating aspect of SPOT is used, to find the different levers to change and see their impact on the final score of the product.

Thanks to SPOT, 100% of new or renovated products have been evaluated in order to communicate the social and environmental profile of each product to the consumers by 2020. Thus, this promotes transparency between the consumer and the group regarding the environmental impact of the products they buy.

2 Experimental

This part is split into two research questions: How applicable are the current company guidance for the luxury packaging: prospects and contradictions in following the 10 rules for eco-design (RQ1) and which are the possibilities and disruptors in cosmetics packaging material recycling (RQ2). For each question, the different methods used are explained based on two studied cases, described in part 2.1.

2.1 Products studied

In Armani and Helena Rubinstein scope, primary packaging are either plastic or glass majority. Thus, the study focuses on one classic Armani product, with simple composition (Fig.9) and one glass product of Helena Rubinstein which is one of the brand's best seller (Fig.10).

2.1.1 Product A

The first product chosen is a 200 ml shower gel from Armani with plastic as the main material.

It is composed of a clear PET plastic bottle of 29.3 grams and a grey PP cap of 6.5 grams.



Fig 9 Product A

2.1.2 Product B

This 50ml glass jar is an iconic product from the Brand Helena Rubinstein, called Powercell Skinmunity. Inside the glass jar there is a plastic jar containing the cream.

The composition is detailed in table 5:

Part	Material	Weight (g)	Color
Glass jar	Soda-lime glass	223.0	Green
Plastic jar	PP	17.5	White
Cap	PP	23.8	Metallized

Table 5 Product B composition



Fig 10 Product B

2.2 RQ1: How applicable the 10 eco-design rules are?

2.2.1 Approach taken

The choice of eco-design improvement is not obvious. Depending on the action chosen, many actors are implied and each little change can end to big consequences. Based on the 10 rules for eco-design, and for both product A and B, main consequences are detailed. This helps to understand the brakes on eco-design. The study is done by interviewing two experts who are responsible for the case products. Interview is open, taking the form of a discussion.

2.2.2 Questionnaire template

The interview is structured according to the 10 eco-design rules. The questions regarding to each of the rule is as follows:

1. Is the rule easy to apply for the product?
2. What is / which are the main challenge(s)?
3. What would make it easier to apply the rule?

As a common question: How to make eco-design in general easier to apply?

The results will be summarized and presented in the template below:

Rule for eco-design	Q&A	
Only use packaging that is safe for human and environmental health	1	
	2	
	3	
Reduce materials use (weight and/or volume)	1	
	2	
	3	
Do not use excess or unnecessary packaging	1	
	2	
	3	
Give preference to large formats whenever possible	1	
	2	
	3	
	1	
	2	

Give preference to materials which have less impact	3	
Only use paper& cardboard that comes from sustainably managed sources	1	
	2	
	3	
Avoid burden shifting wherever possible	1	
	2	
	3	
Reuse	1	
	2	
	3	
Guide consumers in their eco-friendly gestures	1	
	2	
	3	
Make sure your packaging ends its life respectfully	1	
	2	
	3	

Table 6 Questionnaire template

2.3 RQ 2: How to evaluate the recyclability of cosmetics packaging?

2.3.1 Information gathering

In preliminary results it becomes clear that there is lack of understanding on the practical recycling process for different materials and material combination in packages. In order to make recyclability better applied, a tool for visualizing the recycling process was developed. To construct this tool it is important to understand the different steps of the sorting and recyclability processes. Those steps are different if the material is mainly in plastic (product A) or mainly in glass (product B), since both end in different bins so in different facilities.

The recycling process was studied by seeking information from the French company CITEO, specialized in packaging recyclability [73] and by working with the sustainable packaging team from L'Oréal. The attempt was to build a flowchart of the recycling

processes for packages that will help product developers to assess the recyclability of their product.

2.3.2 Flowchart template

For each packaging type, glass or plastic majority, a flowchart is developed, based on the understanding of the sorting and recycling steps and on the disruptors identified. The simplified template of the flowchart is presented below:

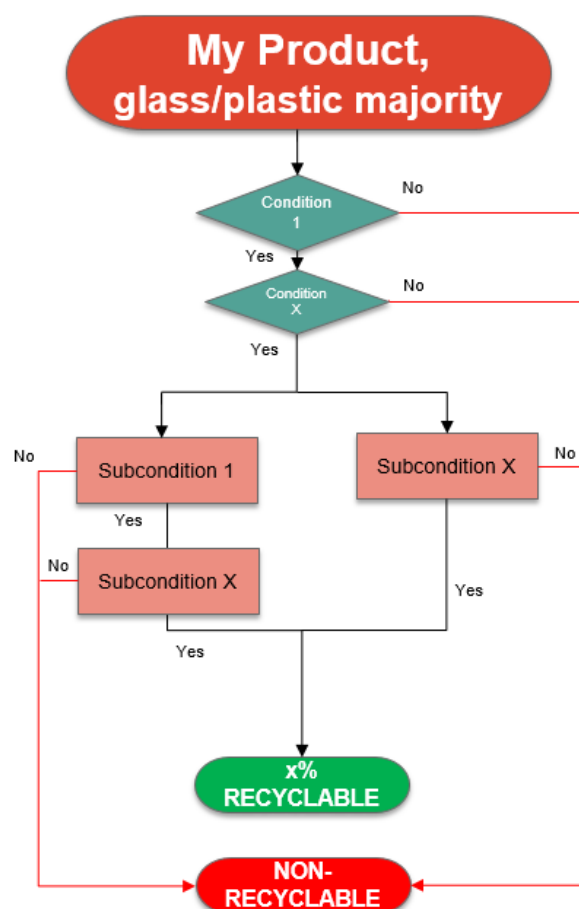


Fig 11 Flowchart template

Beginning at the top of the flowchart, the person checks if the product respects the different conditions and sub-conditions and follows the arrows. At the end, the person using it knows if its product is recyclable or not, and the recyclability percentage obtained. Knowing this percentage for each product of the catalog or for future launches permits to assess the percentage of recyclability of the brand, thus for the group, knowing that the goal is to reach 100% of recyclable or refillable packaging, according to the Ellen MacArthur 2025 commitment.

3 Results

3.1 RQ 1: Applicability of the 10 eco-design rules

The interview lasted about one hour, processing question by question. At the end, the discussion was more opened. All results are a summary of answers given. For some questions, product A and B are clearly separated. If it is not specified, the answer concerns both products.

As a reminder, the three questions for each rule are:

1. Is the rule easy to apply for the product?
2. What is / which are the main challenge(s)?
3. What would make it easier to apply the rule?

Rules for eco-design	Q.	Answers
Only use packaging that is safe for human and environmental health	1	Yes, easy, because we can only use materials validated by L'Oréal.
	2	If we want to develop a new material, we have to test it and it takes time (6 months at least) to make its LCA and to certify they respect the different regulations (FDA, REACH)
	3	Already easy as it is mandatory.
Reduce materials use (weight and/or volume)	1	Not easy for luxury
	2	Consumers perception: the heavier the more luxurious
	3	It would be easier if luxury artwork can be proposed even if lighter weight: There is a need to propose alternative solution in order not to lose the luxury perception. Change/evolution of consumer perception on luxury products: the less is the better.
Do not use excess or unnecessary packaging	1	Depends on the packaging. Some unnecessary parts for the consumer are actually necessary to protect the product
	2	For glass packaging (product B): Glass products are quite fragile, so we need a corrugated carton to hold it safely. Today, no technical solution to remove it. For all packaging: Aesthetic demand for marketing, the product should keep its luxury perception. To justify the price: the more packaging, the more justified the price.

	3	Design stronger/less fragile products. Think about the geometry from the beginning to avoid corrugated carton or additional parts.
Give preference to large formats whenever possible	1	Not easy
	2	Plastic packaging (product A): Consumer perception for plastic product, big formats can be associated with mass-market products. Glass packaging (product B): Big format can be too expensive for the consumer. Today, customer profile do not have the buyer power for large format in luxury. Not easy for travelling
	3	Have a small rechargeable format with the big one as a recharge. This way, the customer can bring the little format is his/her bag and let the big one at home.
Give preference to materials which have less impact	1	Not easy
	2	Plastic packaging: some plastics are not recyclable but have better properties (more shining, more resistant). Sometimes it is not technically feasible to change. If we want to incorporate recycled materials, it can have an aesthetic impact (the color is more greyish) which the market is not ready to have. Also, if there is a lot of recycled PET available as source material, it is not the case of other plastics. Today there is no substitution available for some non-recyclable/less-ecofriendly materials.
	3	Do lot of trials with recyclable/ecofriendly materials to make it more attractive for marketing. Time/money investment needed.
Only use paper& cardboard that comes from sustainably managed sources	1	Easy, already mandatory to use FSC cardboard
	2	No big challenge because all suppliers today already have robust sustainable sources for cardboard and paper (FSC)
	3	/
Avoid burden shifting wherever possible	1	Not easy, any small change could impact the other part of the chain
	2	Example: if we remove the corrugated cardboard, we need additional transportation tests for the e-com. Time and energy consuming.

	3	To have all the tests centralized in order to avoid any burden shifting.
Reuse	1	Not that easy
	2	Requires strong business model to keep it profitable for the company. Development of the recharge is time and cost-consuming.
	3	To have already existing rechargeable packaging to propose. Product A: find bottle of 200ml with recharge that are available in the supplier
Guide consumers in their eco-friendly gestures	1	Not that easy
	2	Because the company proposes products worldwide but regulations are not the same in each country (what to do with the waste of the product). It is time-consuming to shift the consumer behavior (example: to use less water when using shampoo).
	3	To have the same regulations everywhere around the world, especially for recycling
Make sure your packaging ends its life respectfully	1	Not easy
	2	Each country not have the same ability/knowledge for recycle. Consumer behavior: they have to throw the product in the right bin.
	3	To avoid from the design using the material that could disrupt the recyclability of the product or even using materials that are not recyclable at all.

Table 7 Answers for the eco-design questionnaire

Finally, after the interview a global question was asked: How to make the eco-design easier to apply?

Based on the results collected and the final discussion, three main points suggest what should be done to better develop eco-design:

- ➔ Design itself needs to be more and more oriented to be eco-design since the beginning.
- ➔ To guide the marketing, to propose alternative solutions. Time and cost investments are then needed.
- ➔ Lot of communication campaign in order to change the consumer perception, to raise their awareness to use more eco-friendly design.

3.2 RQ 2: Evaluation of the recyclability of cosmetic packaging

3.2.1 Product A recycling

For product A, as the main material is plastic the process is divided into two chains: sorting and recycling. Depending on the country, the steps can vary but the schemes presented are traditional steps of how a plastic product is recycled.

a. Sorting facilities

In this section, I explain the sorting process (sources for the data). The numbers in brackets (x) indicate a potential obstacle for the recycling process. These obstacles are collected in the table 7. Once plastic packaging arrives in the sorting center, they are sorted by a trammel to be separated by size and shape. If a packaging is too small, approximately under 20 ml, it is excluded from the sorting chain (1). Then, a metal sorting is performed thanks to eddy current. Metallic parts are attracted by a magnetic overband. If the metallic part cannot be separated from the plastic package, it can disrupt the sorting of the product (2).

Then, the remaining items go through optical sorting; an infrared laser detects the different materials. Depending on the center, the laser can detect different kinds of resins: PET, PP or PE. If the surface of the product is reflective or if the color is too dark, the laser cannot detect the product, which is then ejected (3). Before baling, human eye remains essential to assure a good quality of sorted materials, regarding the sorting by color, shape or matter (4).

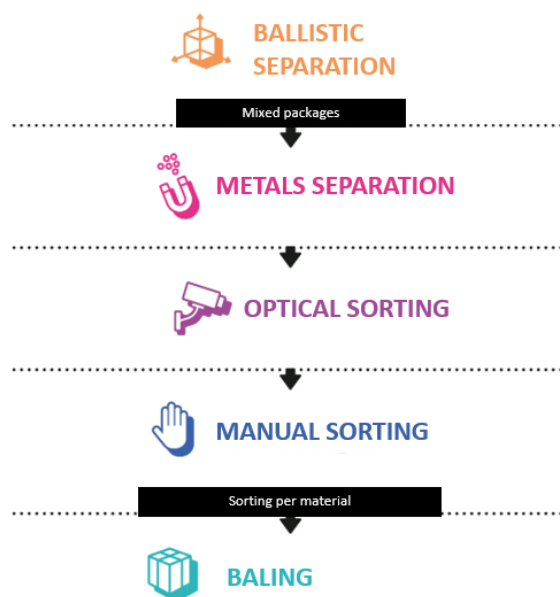


Fig 12 Sorting stages of plastic packaging

Table 7 presents the Disruptors in the different stages of packaging material recycling. The number in brackets (1-4) refer to the further explanation in the text.

Step	Disruptors
Ballistic separation	Product < 20 ml (1)
Metals separation	Mixed plastic/metal packaging, non-magnetic metals (2)
Optical sorting	Reflective surface (metallized surface for example) Dark packaging (3)
Manual sorting	Other resins (PVC, PS, SAN, etc) (4)

Table 8 Sorting disruptors

The identification of those disruptors will help to fill the flowchart in order to determine the recyclability of a product, and what should be changed to make a product recyclable.

b. Mechanical recycling

Once sorted, each material follows its own recycling facility. The plastic bales obtained are opened and undergo optical and metal sorting. This step is optional depending on the center, since this sorting should have already been done in the sorting center. After the shredding where the products are ground up into flakes (1), the items are washed in order to remove impurities as inks or glue that could degrade the quality of the final material (2).

The flotation steps permit to separate the different parts of a product depending on their density (3). As the density of water is 1, the flakes with a density higher than 1 sink, and the one with a density lower than 1 float. Some centers are fitted with another optical sorting step to eliminate undesirable materials: other plastics, metal, etc. and to sort all flakes by color.

Finally, the remaining materials are melted, extruded and shaped into granulates, the final product that will create new packaging.



Fig 13 Recycling stages of plastic packaging

As for the sorting center, a list of disruptors can be established for the recycling process (table 6). Disruptors are the same for optical and metal sorting:

Step	Disruptors
Shredding	Indivisibility of layers or packaging elements, such as plastics with aluminum layer (1)
Washing	Non-washable glues, polluting inks (2)
Flotation	Impossible separability of materials with similar densities (elements of $d > 1$ on PET packaging, $d < 1$ for PE/PP packaging) (3)

Table 9 Recycling disruptors

c. Plastic majority product flowchart

With the disruptors identified for both sorting and recycling processes and based on the Ellen MacArthur conditions, the flowchart for plastic majority product is set up.

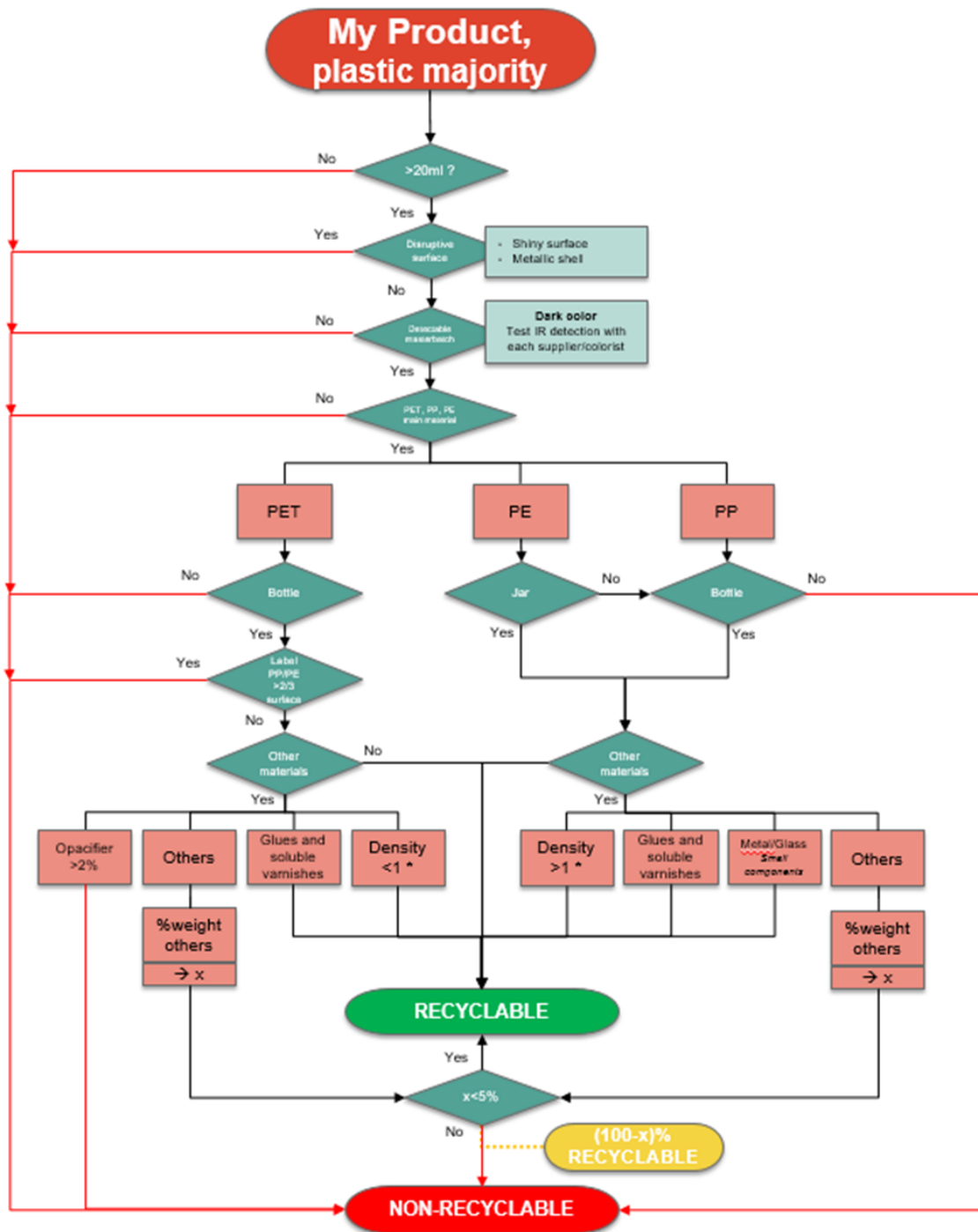
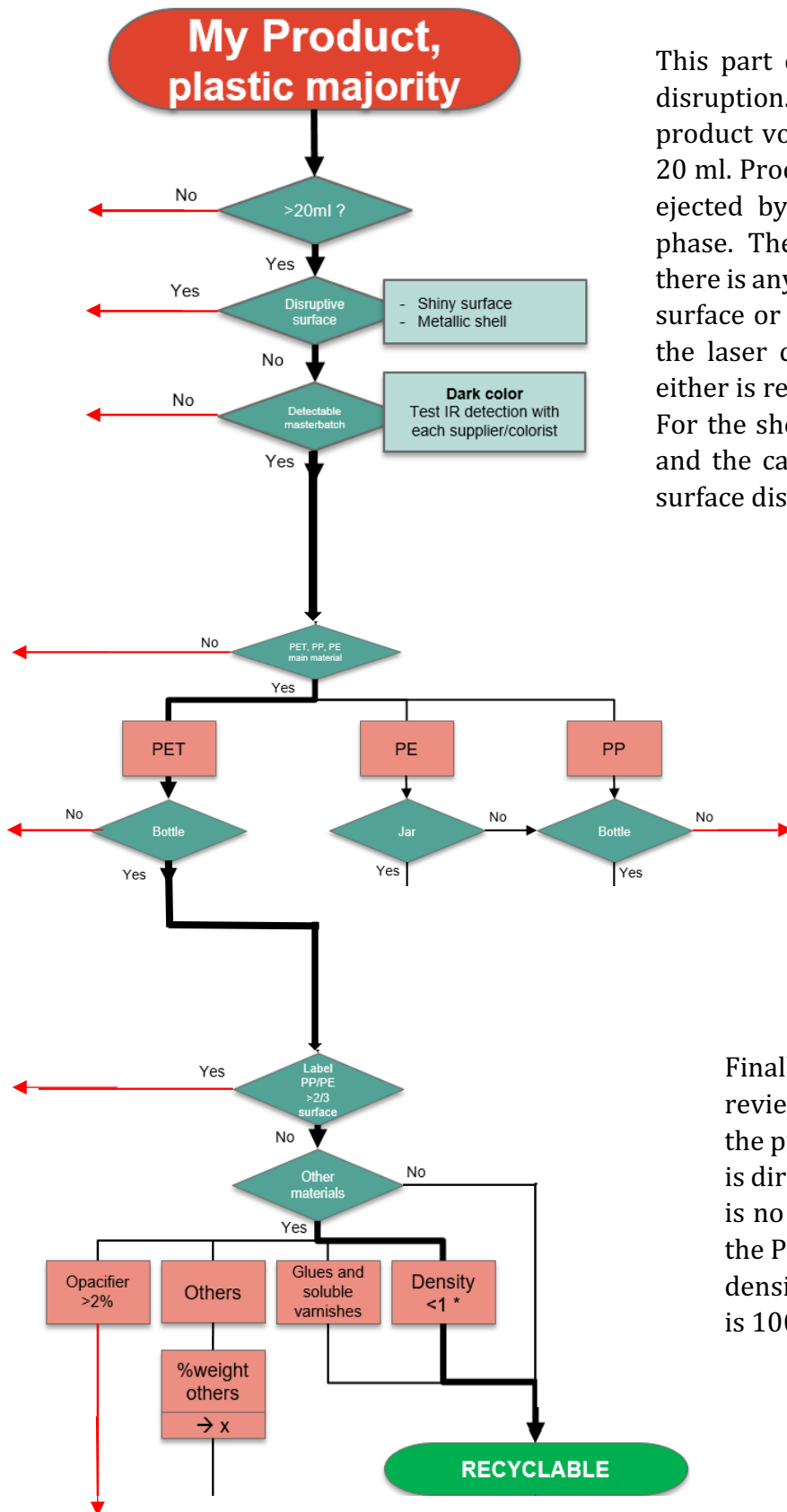


Fig 14 Recyclability flowchart for plastic packaging

d. Product A recyclability evaluation

The flowchart is a tool to determine the recyclability of a product. Thus, product A recyclability can be assessed following the different tool's paths, represented by bold arrows. Red arrows go to the “non-recyclable” tag.



This part concerns the format and artwork disruption. The first parameter to check is the product volume, if it is higher or lower than 20 ml. Product A is a 200ml bottle so it is not ejected by the trammel during the sorting phase. Then, the person needs to check if there is any disruptive surface such as shining surface or dark masterbatch. If it is the case, the laser can not detect the plastic since it either is reflected or absorbed by the surface. For the shower gel, the bottle is transparent and the cap grey, so there is no problem of surface disruption.

According to the Ellen MacArthur commitment, only PET, PE and PP bottles and PE jars are recyclable formats. The PET bottle of product A is then a good candidate to be recycled.

Finally, the last part of the flowchart reviews the other elements composing the product. In the present case, the text is directly written on the bottle, so there is no disruptive label. The other part of the PET bottle is the PP cap, which has a density lower than one. Thus, product A is 100% recyclable.

Fig 15 Flowchart of product A recyclability

3.2.2 Product B recycling

a. Mechanical recycling

The product B is mainly composed of glass so it ends in a different bin, specialized for glass items. After being collected, the first step is the maturation. This passive cleaning allows to eliminate organic part in the open air. Then a manual sorting permits to sort all big elements different from glass material; it can be cardboard or plastic products that where sorted in the wrong bin. Magnetic metallic elements are then expelled thanks to a magnet and eddy current. The next step is the shredding, as for plastic the product are ground up and the glass is transformed into cullet of various sizes. The screening sorts cullet by size, from 10 to 15mm, calibrated at the request of glassmakers. Light elements such as plastic are then ejected during the blasting stage.

Finally, the optical sorting is the crucial step, with three roles. The laser detects the opacity of materials in order to identify and eject infusible materials, such as ceramics that have a melting temperature higher than the one of the glass. Those infusible materials can degrade the quality of the recycled glass since they do not melt. Thus, if the surface is reflective or if the cullet is opaque, the laser does not detect the glass. The laser also sorts colorless cullet from colored one, depending on the glassmaker wish. Finally, it conducts a separation by nature of glass, keeping only soda-lime glass. All other glass types are ejected.

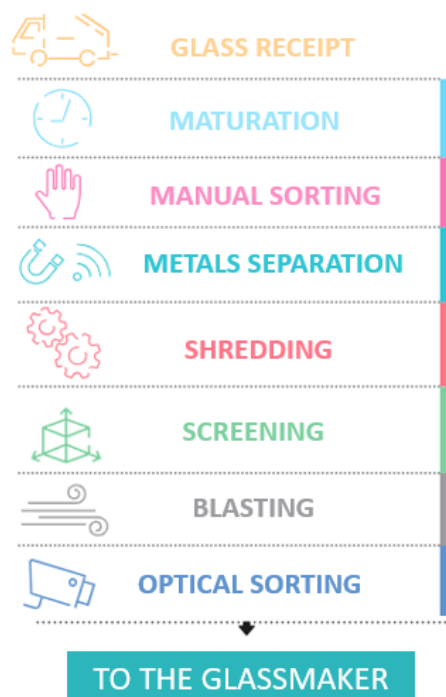


Fig 16 Sorting steps of glass packaging

Cullet are finally sent to the glassmaker. After another maturation and fusion at 1550°C, new items are made.

Disruptors for glass recycling are summarized in the table below:

Step	Disruptors
Manual sorting	Undesirable materials other than glass
Metals sorting	Non-magnetic metals
Optical sorting	Non-sodalime glass Opaque or reflective surfaces

Table 10 Disruptors for glass sorting

Thus, for cosmetic products the main constraint is the opacity of the glass. However, if the initial product is free from disruptors, the glass can be infinitely recycled.

b. Glass majority flowchart

The translation of the disruptors identified into a recycling flowchart is presented by Fig 17.

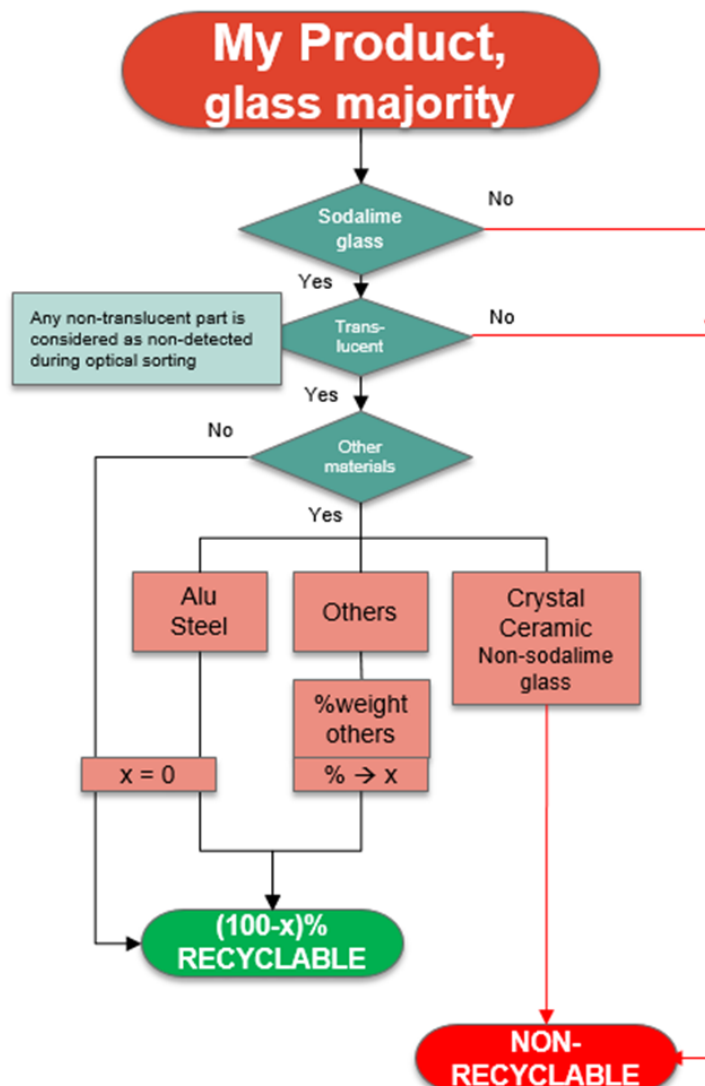
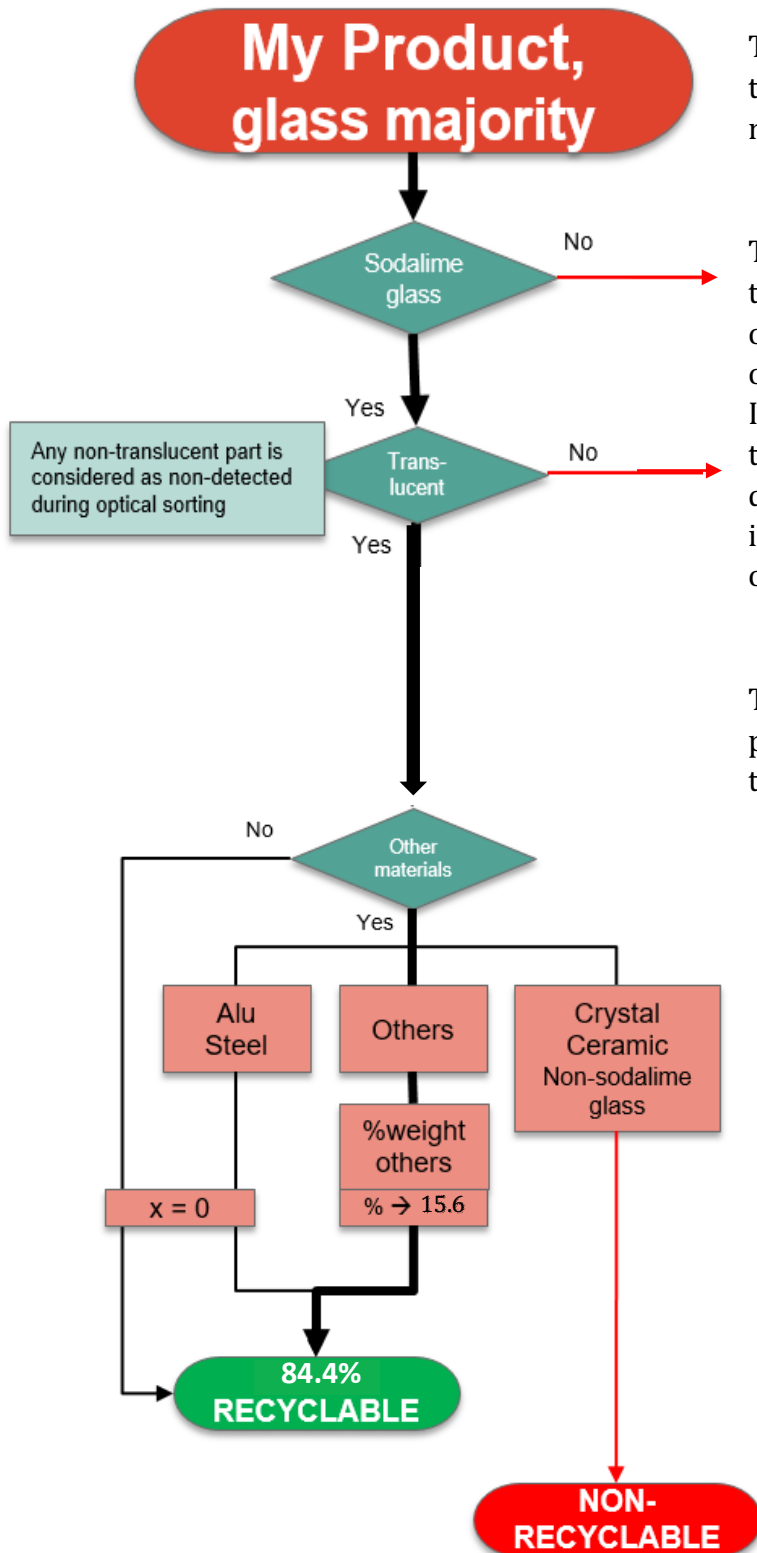


Fig 17 Recyclability flowchart for glass packaging

c. Product B recyclability evaluation

As for product A, the assessment of product B is realized using the flowchart of glass majority packaging, step by step.



The first thing to check is the nature of the glass. Only soda-lime glass is indeed recyclable. This is the case of product B.

Then, the only thing that could prevent the recycling of glass packaging is its opacity. In our case, the glass is not fully opaque, but it is not translucent either. In this case, the product should be sent to a recycling center to test its detectability by the laser. It is assumed in this study that the product passes the optical sorting.

The metallized PP cap and the PP jar of product B will not be recycled. However, those parts do not disrupt the glass recyclability, so they correspond to the "Others" tag.

To establish the final recyclability percentage of the product, the amount of "others" parts is calculated.

Based on the composition of product B, the total weight of the packaging is 264.3g, with 223.0g of glass and 41.3g of PP parts.

Thus, other parts represent 15.6% of the total weight of the product. The final product is then calculated with $100 - 15.6 = 84.4$. The recyclability of product B is 84.4%.

Fig 18 Flowchart of product B recyclability

Conclusion

Many factors encourage companies to contribute to sustainable development and to reduce their negative impacts on their products and activities. The luxury sector is not exempted. It should be proactive and exemplary to propose impeccable and sustainable products, desirable for its consumers. Special attention is given to packaging, often associated with waste and sometimes with toxicity. Yet, they play an essential role to assure the sales, protection and ease to use.

The problematic of this thesis was to propose solutions to improve the environmental impact of Armani and Helena Rubinstein, two luxury brands from L'Oréal, with a focus on packaging. To answer to this problematic, we have studied eco-design rules for packaging and the challenges implicated. Then, we made researches on plastic and glass packaging recyclability.

Thus, this thesis gave knowledges about the different actions that can be conducted to make a packaging greener. By interviewing two product developers, we understood that many of those actions imply an aesthetic change that can change customer perception. To better integrate eco-design, more alternatives should be found, without changing the product quality. Furthermore, eco-design should be thought from the beginning, when the marketing proposes a project, and we need to communicate more on the environment to heighten customer awareness.

Then, a big part of my work was to understand the functioning of sorting and recycling facilities for both plastic and glass packaging. This abled to give a list of recycling disruptors; for cosmetic packaging the main disruptors are the shiny surfaces that are not detected by the laser, some materials used are not recyclables, and little products, make-up most of the time, are too small to be recycled. To help product developers to assess the recyclability of their products, a flowchart was set up. This tool permits to calculate the percentage of recyclability of a glass or plastic packaging.

Limits and perspectives

As recycling and sorting centers are different depending on the countries, the flowchart was inspired by the French recycling company CITEO and the Ellen MacArthur commitment. Thus, it is not a universal tool. Over the years and depending on the country, it can be changed. At L'Oréal, it is not defined yet how this flowchart is going to be used. The question now is how to make this tool the easiest and for who it will be addressed: the marketing? Product developers?

I was surprised during my research work to see that sustainability is a very old concept and that the questions thirty years ago are the same today. However, this project made me realize that sustainability is a very long process that implies a lot of actors, time and cost. I think it is very important to have an ambitious program with clear objectives.

References

- [1] Financial Communications Department and the Branding and Corporate Image, *L'Oréal 2019 Annual report*, 2019
- [2] L'Oréal, *Armani L'Oréal Luxe*, www.loreal.com/fr/loreal-luxe/armani/
- [3] L'Oréal, *Helena Rubinstein L'Oréal Luxe*, www.loreal.com/fr/loreal-luxe/helena-rubinstein/
- [4] Brundtland, *Report of the World Commission on Environment and Development: Our Common Future*, 1987
- [5] Purvis, Y. Mao, D. Robinson, *Three pillars of sustainability: in search of conceptual origins*, Integrated Research System for Sustainability Science, Tokyo, 2018
- [6] European Commission, *the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan*, 2008, p.3
- [7] United Nations, *Child Labour*, Sustainable Development Goals, 2015, www.un.org/sustainabledevelopment/blog/tag/child-labour/
- [8] UNEP, *Program for the environment*, www.unep.ch/scoe/documents/fr_CSO.pdf
- [9] European Commission, *A renewed EU strategy 2011-14 for Corporate Social Responsibility*, 2011
- [10] A. Carroll, *The pyramid of corporate social responsibility: Towards the moral management of organizational stakeholders*, *Business Horizons*, 1991, 34, 39-48.
- [11] A.P. Duarte, *Corporate social responsibility from an employees' perspective: Contributes for understanding job attitudes*, ISCTE-Instituto Universitário de Lisboa, 2011
- [12] H. Tacker, *What is the importance of CSR?*, *The CSR journal*, 2019
- [13] J. Oakes, *Sustainable Luxury: Millennials Buy Into Socially Conscious Brands*, *Luxe Digital*, 2020
- [14] L'Oréal progress report, *Sharing Beauty With All: L'Oréal's commitment to sustainability*, 2018
- [15] United Nations, *Sustainable Development Goals*, 2015
- [16] Armani, *Acqua for Life Giorgio Armani*, 2019, www.giorgioarmanibeauty-usa.com/landing-pages/acqua-for-life/
- [17] l'Oréal, *Plastic Packaging Policy*, www.loreal.com/en/articles/sharing-beauty-with-all/plastic-packaging-policy/
- [18] Foundation EllenMacArthur, *Ellen MacArthur*, www.ellenmacarthurfoundation.org/our-story/the-team/ceo-trustees/ellen-macarthur
- [19] Foundation EllenMacArthur, *Mission*, www.ellenmacarthurfoundation.org/our-story/mission
- [20] L'Oréal, *Low Carbon Growth: Our Strategy*, www.loreal.com/en/articles/sharing-beauty-with-all/low-carbon-growth-a-new-ambition/
- [21] Science Based Target, *What is Science based target ?*, www.sciencebasedtargets.org/what-is-a-science-based-target/
- [22] Salehzadeh, Reza; Pool, Javad, *Brand Attitude and Perceived Value and Purchase Intention toward Global Luxury Brands*, *Journal of International Consumer Marketing*, 2016, p.74–82.
- [23] A. Béosièrè, *Développement durable et luxe sont-ils compatibles ?*, *la Tribune*, 2011

- [24] J. Bendell, J., & 1A. Kleanthous, *Deeper luxury : Quality and style when the world matters*, World Wildlife Fund - WWF, UK Report, 2007
- [25] A. Sahota, *Sustainability: How the Cosmetics Industry is Greening Up*, 2013
- [26] J. Kapferer, A. Michaut, *Is luxury compatible with sustainability? Luxury consumers' viewpoint*, Journal of Brand Management, 2014
- [27] J. Kapferer, A. Michaut, *Luxury and sustainability: a common future? The match depends on how consumers define luxury*, 2010
- [29] N. Gilet, C. Brown, J. Ortega, *Reinventing Luxury: Sustainability as a Way Forward*, WWD, 2019
- [30] Journal du Luxe, *La Division Luxe de L'Oréal s'envole*, 2019
- [31] Kering, *Sustainability*, www.kering.com/en/sustainability/
- [32] N. Loeser, *A Brief History of Packaging*, Structural Graphics Blog, 2015, www.structuralgraphics.com/blog/a-brief-history-of-packaging/
- [33] Dr. K. R. Subramanian, *Impact of Packaging in Self Service Marketing*, International journal of scientific progress and research, 2017
- [34] Benjamin, *The 3 Levels of Packaging*, the Packaging Company, 2018, www.thepackagingcompany.us/knowledge-sharing/3-levels-of-packaging/
- [35] Picture from Sam Parfum shop website., www.samparfums.es/gb/fragancias-femeninas/giorgio-armani-si-passione-edp-00ml-97573.html
- [36] Picture from AllPack Direct, *Corrugated cartons single wall*, www.allpack.co.uk/cartons.htm
- [37] S. Chand, *5 Basic Functions of Packaging in Marketing a Product*, YourArticleLibrary
- [38] Centre National d'Information Indépendante sur les Déchets, *Réduire les déchets d'emballages : pourquoi et comment ?*, www.cniid.org/Reduire-les-dechets-d-emballages-pourquoi-et, 321
- [39] All4Pack, *l'emballage dans le monde*, 2018
- [40] COTREP, *Recyclability of plastic packaging*, 2019
- [41] R. Harrington, *By 2050, the oceans could have more plastic than fish*, Business Insider, 2017
- [42] Plastic Europe, *An analysis of European plastics production, demand and waste data*, 2014
- [43] Thompson et al., *Plastics, the environment and human health: current consensus and future trends*, 2009
- [44] Tap Water, *Glass vs plastic vs aluminium – what is the most sustainable choice?*, 2019
- [45] CO website, *How Sustainable Is Paper And Cardboard Packaging?*, 2020, www.commonobjective.co/article/how-sustainable-is-paper-and-cardboard-packaging
- [46] R. Wever, E. Tempelman, *The Social Component of Sustainable Packaging*, 2009
- [47] H. Lewis, *Defining product stewardship and sustainability in the Australian packaging industry*, 2005
- [48] S. Koetting, *Trends in Luxury Packaging Emphasize Materials, Shapes, Color, Typography & Imagery*, Packaging Strategies, 2017
- [49] Politech website, *Packaging + Weight = Luxury ?*, www.politech.pl/en/blog/packaging-weight-luxury/
- [50] CITEO, *Etude Shopper Luxe: Comment éco-concevoir dans le luxe?*, 2019
- [51] MP Médias, *L'emballage de luxe : un marché de 15 milliards de dollars*, Pap'Argus, 2016
- [52] S. Owens, *Millennials Demand Transparency From Luxury Brands*, Jing Daily, 2017

- [53] Mugler website, *Mugler Fountain*, www.inter.mugler.com/fragrance/the-mugler-fountain/
- [54] Verescence, *Shared perspectives on eco-design between Verescence & Guerlain*, 2019
- [55] Kiehl's website, *Made-better*, url: <https://www.kiehls.com/made-better#>
- [56] European Parliament and Council, *Regulation (EC) No 1223/2009 on the cosmetics*, Official Journal of the European Union, 2009
- [57] European Parliament and Council, *DIRECTIVE 94/62/EC of 20 December 1994 on packaging and packaging waste*, Official Journal of the European Union, 1994
- [58] European Parliament and Council, *Directive (EU) 2018/852 of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste*, Official Journal of the European Union, 2018
- [59] European Chemical Agency, *About the REACH Regulation*, 2011
- [60] Commission of the European communities, *Environmental issues of PVC*, 2000
- [61] L'Oréal website, *100% responsible packaging is possible!*, www.loreal-finance.com/en/annual-report-2017/operations/environment-responsible-packaging
- [62] Commission of the European communities, *COMMISSION DIRECTIVE 2002/72/EC relating to plastic materials and articles intended to come into contact with foodstuffs*, 2002
- [63] L'Oréal website, *Achieving "zero Deforestation"*, www.loreal.com/en/articles/sharing-beauty-with-all/achieving-zero-deforestation/
- [64] Natura-Sciences, *FSC & PEFC: pour des forêts durables*, 2014
- [65] Sustainability Guide, *Ecodesign*, www.sustainabilityguide.eu/ecodesign/
- [66] European Parliament and Council, *DIRECTIVE 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products*, Official Journal of the European Union, 2009
- [67] ENEC, *Envisioning Ecodesign*, 2015
- [68] Pôle Ecoconception, *Ecodesign*, 2016, www.eco-conception.fr/
- [69] Cambridge dictionary online, *definition of greenwashing*, www.dictionary.cambridge.org/dictionary/english/greenwashing
- [70] ISO, *ISO 14020:2000 Environmental labels and declarations*, 2000
- [71] L'Oréal internal document, *Environmental Packaging guide*, 2017
- [72] L'Oréal website, *A New Tool To Assess The Environmental And Social Impact Of Our Products*, www.loreal.com/en/articles/sharing-beauty-with-all/a-new-tool-to-assess-the-environmental-and-social-impact-of-our-products/
- [73] CITEO, *Recyclabilité des emballages de la beauté*, 2019